



4-Bit Bidirectional Universal Shift Register

The MC74AC194/74ACT194 is a high-speed 4-bit bidirectional universal shift register. As a high-speed multifunctional, sequential building block, it is useful in a wide variety of applications. It may be used in serial-serial, shift left, shift right, serial-parallel, parallel-serial, and parallel-parallel data register transfers. The 'AC/ACT194 is similar in operation to the 'AS195 universal shift register, with added features of shift left without external connections and hold (do nothing) modes of operation.

- Typical Shift Frequency of 150 MHz
- Asynchronous Master Reset
- Hold (Do Nothing) Mode
- Fully Synchronous Serial or Parallel Data Transfers

FUNCTIONAL DESCRIPTION

The MC74AC/74ACT194 contains four edge-triggered D flip-flops and the necessary interstage logic to synchronously perform shift right, shift left, parallel load and hold operations. Signals applied to the Select (S_0 , S_1) inputs determine the type of operation, as shown in the Mode Select Table. Signals on the Select, Parallel data (P_0 – P_3) and Serial data (DSR , DSL) inputs can change when the clock is in either state, provided only that the recommended setup and hold times, with respect to the clock rising edge, are observed. A LOW signal on Master Reset (MR) overrides all other inputs and forces the outputs LOW.

MODE SELECT TABLE

Operating Mode	Inputs					Outputs				
	MR	S_1	S_0	DSR	DSL	P_n	Q_0	Q_1	Q_2	Q_3
Reset	L	X	X	X	X	X	L	L	L	L
Hold	H	I	I	X	X	X	q_0	q_1	q_2	q_3
Shift Left	H	h	I	X	I	X	q_1	q_2	q_3	L
	H	h	I	X	h	X	q_1	q_2	q_3	H
Shift Right	H	I	h	I	X	X	L	q_0	q_1	q_2
	H	I	h	h	X	X	H	q_0	q_1	q_2
Parallel Load	H	h	h	X	X	P_n	P_0	P_1	P_2	P_3

I = LOW voltage level one setup time prior to the LOW-to-HIGH clock transition.

h = HIGH voltage level one setup time prior to the LOW-to-HIGH clock transition.

P_n (q_n) = Lower case letters indicate the state of the referenced input (or output) one setup time prior to the LOW-to-HIGH clock transition.

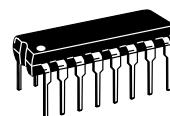
H = HIGH Voltage Level

L = LOW Voltage Level

X = Immaterial

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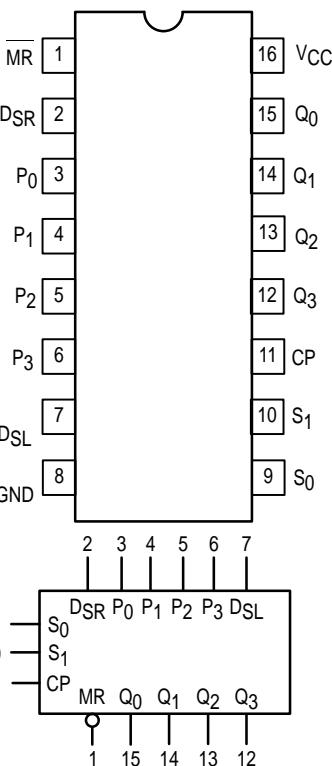
4-BIT BIDIRECTIONAL UNIVERSAL SHIFT REGISTER



N SUFFIX
CASE 648-08
PLASTIC

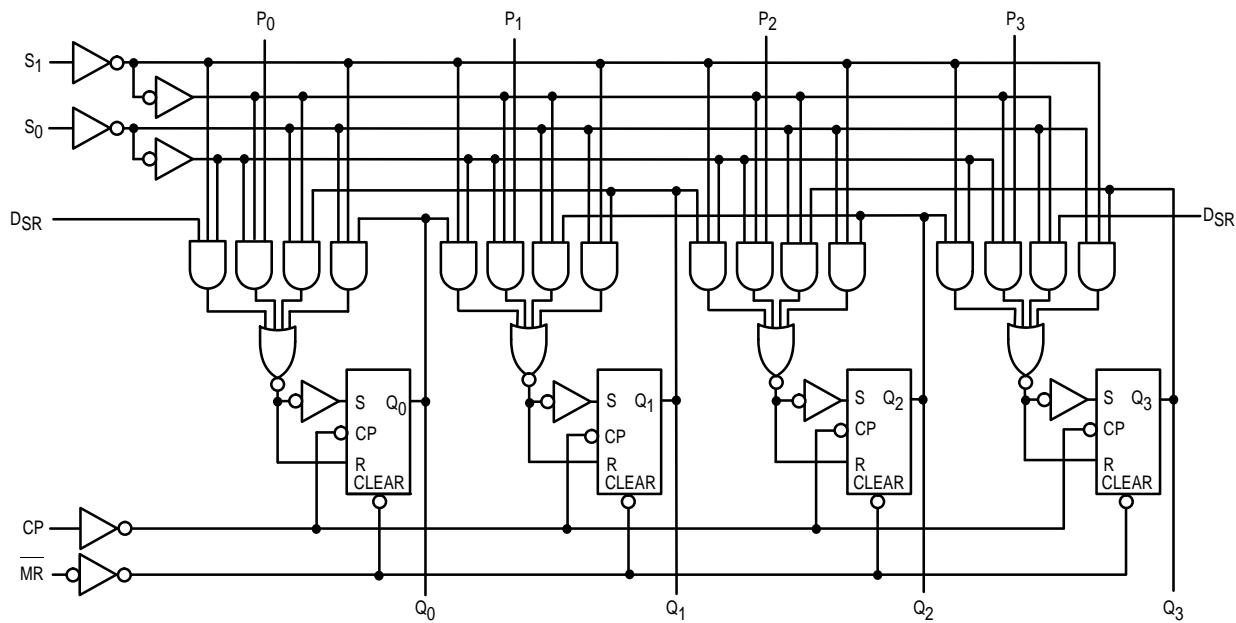


D SUFFIX
CASE 751B-05
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LOGIC DIAGRAM



Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

MAXIMUM RATINGS*

Symbol	Parameter	Value	Unit
V_{CC}	DC Supply Voltage (Referenced to GND)	-0.5 to +7.0	V
V_{in}	DC Input Voltage (Referenced to GND)	-0.5 to V_{CC} +0.5	V
V_{out}	DC Output Voltage (Referenced to GND)	-0.5 to V_{CC} +0.5	V
I_{in}	DC Input Current, per Pin	± 20	mA
I_{out}	DC Output Sink/Source Current, per Pin	± 50	mA
I_{CC}	DC V_{CC} or GND Current per Output Pin	± 50	mA
T_{stg}	Storage Temperature	-65 to +150	°C

* Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the Recommended Operating Conditions.

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RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Unit
V _{CC}	Supply Voltage	'AC	2.0	5.0	6.0
		'ACT	4.5	5.0	5.5
V _{in} , V _{out}	DC Input Voltage, Output Voltage (Ref. to GND)	0		V _{CC}	V
t _r , t _f	Input Rise and Fall Time (Note 1) 'AC Devices except Schmitt Inputs	V _{CC} @ 3.0 V	150		ns/V
		V _{CC} @ 4.5 V	40		
		V _{CC} @ 5.5 V	25		
t _r , t _f	Input Rise and Fall Time (Note 2) 'ACT Devices except Schmitt Inputs	V _{CC} @ 4.5 V	10		ns/V
		V _{CC} @ 5.5 V	8.0		
T _J	Junction Temperature (PDIP)			140	°C
T _A	Operating Ambient Temperature Range	-40	25	85	°C
I _{OH}	Output Current — High			-24	mA
I _{OL}	Output Current — Low			24	mA

1. V_{in} from 30% to 70% V_{CC}; see individual Data Sheets for devices that differ from the typical input rise and fall times.

2. V_{in} from 0.8 V to 2.0 V; see individual Data Sheets for devices that differ from the typical input rise and fall times.

DC CHARACTERISTICS

Symbol	Parameter	V _{CC} (V)	74AC		Unit	Conditions
			T _A = +25°C	T _A = -40°C to +85°C		
			Typ	Guaranteed Limits		
V _{IH}	Minimum High Level Input Voltage	3.0 4.5 5.5	1.5 2.25 2.75	2.1 3.15 3.85	V	V _{OUT} = 0.1 V or V _{CC} - 0.1 V
V _{IL}	Maximum Low Level Input Voltage	3.0 4.5 5.5	1.5 2.25 2.75	0.9 1.35 1.65	V	V _{OUT} = 0.1 V or V _{CC} - 0.1 V
V _{OH}	Minimum High Level Output Voltage	3.0 4.5 5.5	2.99 4.49 5.49	2.9 4.4 5.4	V	I _{OUT} = -50 μA
		3.0 4.5 5.5		2.56 3.86 4.86	V	*V _{IN} = V _{IL} or V _{IH} -12 mA I _{OH} -24 mA -24 mA
V _{OL}	Maximum Low Level Output Voltage	3.0 4.5 5.5	0.002 0.001 0.001	0.1 0.1 0.1	V	I _{OUT} = 50 μA
		3.0 4.5 5.5		0.36 0.36 0.36	V	*V _{IN} = V _{IL} or V _{IH} 12 mA I _{OL} 24 mA 24 mA
I _{IN}	Maximum Input Leakage Current	5.5		±0.1	μA	V _I = V _{CC} , GND
I _{OLD}	†Minimum Dynamic Output Current	5.5		75	mA	V _{OLD} = 1.65 V Max
I _{OHD}		5.5		-75	mA	V _{OHD} = 3.85 V Min
I _{CC}	Maximum Quiescent Supply Current	5.5		8.0	μA	V _{IN} = V _{CC} or GND

* All outputs loaded; thresholds on input associated with output under test.

† Maximum test duration 2.0 ms, one output loaded at a time.

Note: I_{IN} and I_{CC} @ 3.0 V are guaranteed to be less than or equal to the respective limit @ 5.5 V V_{CC}.

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AC CHARACTERISTICS (For Figures and Waveforms — See Section 3)

Symbol	Parameter	V _{CC} * (V)	74AC		74AC		Unit	Fig. No.		
			T _A = +25°C C _L = 50 pF		T _A = -40°C to +85°C C _L = 50 pF					
			Min	Max	Min	Max				
f _{max}	Maximum Input Frequency	3.3 5.0	130 210		115 150		MHz	3-3		
t _{PLH}	Propagation Delay CP to Q	3.3 5.0	2.0 2.0	14.5 12.5	1.5 1.5	16.0 14.0	ns	3-6		
t _{PHL}	Propagation Delay CP to Q	3.3 5.0	2.0 2.0	14.5 12.5	1.5 1.5	16.0 14.0	ns	3-6		
t _{PHL}	Propagation Delay Reset to Q	3.3 5.0	2.0 2.0	11.0 9.0	1.5 1.5	12.0 10.0	ns	3-6		

* Voltage Range 3.3 V is 3.3 V \pm 0.3 V.

Voltage Range 5.0 V is 5.0 V \pm 0.5 V.

AC OPERATING REQUIREMENTS

Symbol	Parameter	V _{CC} * (V)	74AC		74AC		Unit	Fig. No.		
			T _A = +25°C C _L = 50 pF		T _A = -40°C to +85°C C _L = 50 pF					
			Guaranteed Minimum							
t _s	Setup Time, P _n to Clock	3.3 5.0	4.0 2.5		5.0 3.5		ns	3-9		
t _h	Hold Time, P _n to Clock	3.3 5.0	3.5 2.0		4.0 2.5		ns	3-9		
t _s	Setup Time, S _n to CP	3.3 5.0	5.5 4.0		6.5 5.0		ns	3-9		
t _h	Hold Time, S _n to CP	3.3 5.0	3.5 2.0		4.0 2.5		ns	3-9		
t _s	Setup Time, DSR or DSL to Clock	3.3 5.0	5.5 4.0		6.0 4.5		ns	3-9		
t _h	Hold Time, DSR or DSL to Clock	3.3 5.0	1.5 2.0		2.0 2.5		ns	3-9		
t _w	CP Pulse Width	3.3 5.0	5.5 4.0		6.0 4.5		ns	3-6		
t _w	MR Pulse Width	3.3 5.0	5.5 4.0		6.0 4.5		ns	3-9		
t _{rec}	Recovery Time MR to CP	3.3 5.0	1.5 1.0		1.5 1.0		ns	3-9		

* Voltage Range 3.3 V is 3.3 V \pm 0.3 V.

Voltage Range 5.0 V is 5.0 V \pm 0.5 V.

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DC CHARACTERISTICS

Symbol	Parameter	V _{CC} (V)	74ACT		74ACT		Unit	Conditions		
			T _A = +25°C		T _A = -40°C to +85°C					
			Typ	Guaranteed Limits						
V _{IH}	Minimum High Level Input Voltage	4.5 5.5	1.5 1.5	2.0 2.0	2.0		V	V _{OUT} = 0.1 V or V _{CC} - 0.1 V		
V _{IL}	Maximum Low Level Input Voltage	4.5 5.5	1.5 1.5	0.8 0.8	0.8		V	V _{OUT} = 0.1 V or V _{CC} - 0.1 V		
V _{OH}	Minimum High Level Output Voltage	4.5 5.5	4.49 5.49	4.4 5.4	4.4		V	I _{OUT} = -50 μA		
		4.5 5.5		3.86 4.86	3.76		V	*V _{IN} = V _{IL} or V _{IH} I _{OH} -24 mA		
V _{OL}	Maximum Low Level Output Voltage	4.5 5.5	0.001 0.001	0.1 0.1	0.1		V	I _{OUT} = 50 μA		
		4.5 5.5		0.36 0.36	0.44		V	*V _{IN} = V _{IL} or V _{IH} I _{OL} 24 mA		
I _{IN}	Maximum Input Leakage Current	5.5		±0.1	±1.0		μA	V _I = V _{CC} , GND		
ΔI _{CCT}	Additional Max. I _{CC} /Input	5.5	0.6		1.5		mA	V _I = V _{CC} - 2.1 V		
I _{OLD}	†Minimum Dynamic Output Current	5.5			75		mA	V _{OLD} = 1.65 V Max		
I _{OHD}		5.5			-75		mA	V _{OHD} = 3.85 V Min		
I _{CC}	Maximum Quiescent Supply Current	5.5		8.0	80		μA	V _{IN} = V _{CC} or GND		

* All outputs loaded; thresholds on input associated with output under test.

† Maximum test duration 2.0 ms, one output loaded at a time.

AC CHARACTERISTICS (For Figures and Waveforms — See Section 3)

Symbol	Parameter	V _{CC} * (V)	74ACT			74ACT		Unit	Fig. No.		
			T _A = +25°C C _L = 50 pF			T _A = -40°C to +85°C C _L = 50 pF					
			Min	Typ	Max	Min	Max				
f _{max}	Maximum Input Frequency	5.0	210			150		MHz	3-3		
t _{PLH}	Propagation Delay CP to Q	5.0	2.0		13.0	1.5	13.5	ns	3-6		
t _{PHL}	Propagation Delay CP to Q	5.0	2.0		12.5	1.5	14.0	ns	3-6		
t _{PHL}	Propagation Delay MR to Q	5.0	2.0		12.5	1.5	14.0	ns	3-6		

* Voltage Range 5.0 V is 5.0 V ±0.5 V.

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AC OPERATING REQUIREMENTS

Symbol	Parameter	V _{CC} * (V)	74ACT	74ACT	Unit	Fig. No.
			T _A = +25°C C _L = 50 pF	T _A = -40°C to +85°C C _L = 50 pF		
			Guaranteed Minimum			
t _s	Setup Time, P _n to CP	5.0	2.5	3.5	ns	3-9
t _h	Hold Time, P _n to CP	5.0	1.5	2.0	ns	3-9
t _s	Setup Time, S _n to CP	5.0	3.5	4.5	ns	3-9
t _h	Hold Time, S _n to CP	5.0	1.5	2.0	ns	3-9
t _s	Setup Time, DSR or DSL to Clock	5.0	5.0	5.5	ns	3-9
t _h	Hold Time, DSR or DSL to Clock	5.0	1.5	2.0	ns	3-9
t _w	CP Pulse Width	5.0	4.0	4.5	ns	3-9
t _w	MR Pulse Width, LOW	5.0	4.0	4.5	ns	3-9
t _{rec}	Recovery Time MR to CP	5.0	1.0	1.5	ns	3-9

* Voltage Range 5.0 V is 5.0 V \pm 0.5 V.

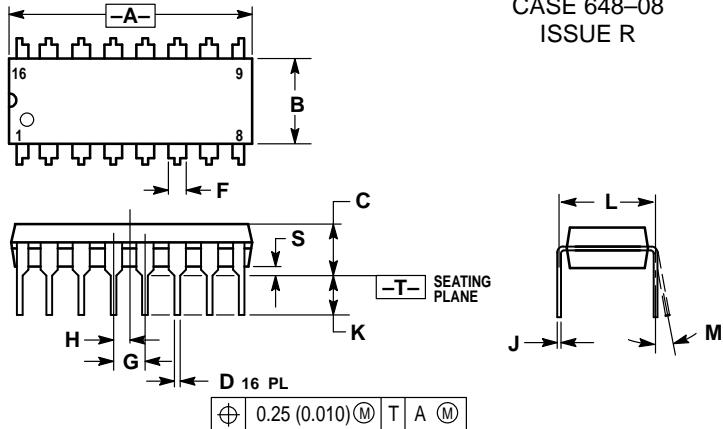
CAPACITANCE

Symbol	Parameter	Value Typ	Unit	Test Conditions
C _{IN}	Input Capacitance	4.5	pF	V _{CC} = 5.0 V
C _{PD}	Power Dissipation Capacitance	125.0	pF	V _{CC} = 5.0 V

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OUTLINE DIMENSIONS

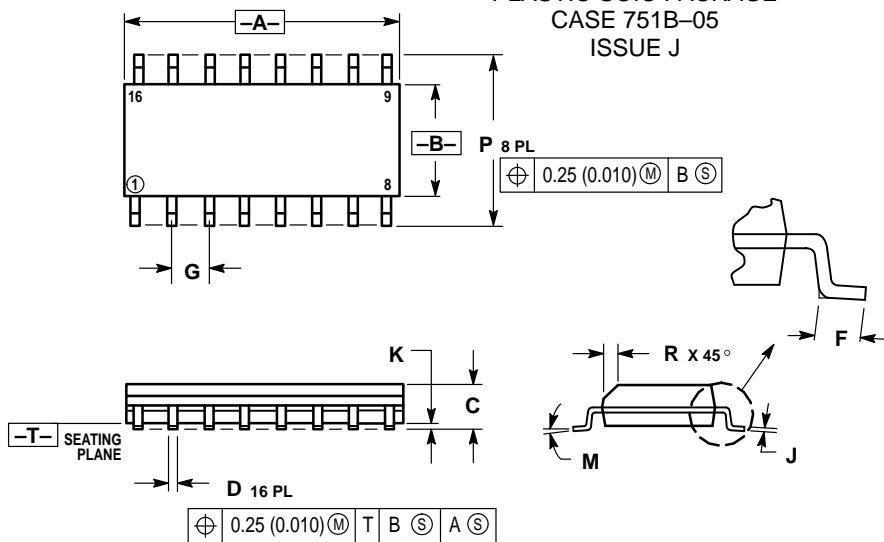
N SUFFIX PLASTIC DIP PACKAGE CASE 648-08 ISSUE R



NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
 4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
 5. ROUNDED CORNERS OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0°	10°	0°	10°
S	0.020	0.040	0.51	1.01

D SUFFIX PLASTIC SOIC PACKAGE CASE 751B-05 ISSUE J



NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MILLIMETER.
 3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
 4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
 5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

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